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NEURAL CORRELATE OF MEMORY ENHANCEMENT DURING PHYSICAL EXERCISE

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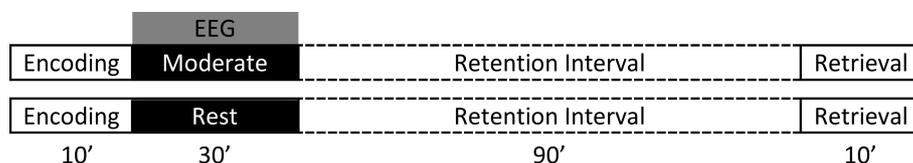
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Introduction

Research has shown that physical exercise is beneficial for cognitive performance¹. In addition to psychological effects, many effects are attributable to physiological mechanisms such as increased blood flow and oxygen supply (cardiovascular hypothesis²). It is, however, unclear whether any neural mechanisms contribute to this process. In two studies, we explored this possibility by recording EEG while participants were cycling following memorising a set of stimuli for later recognition.

Study 1

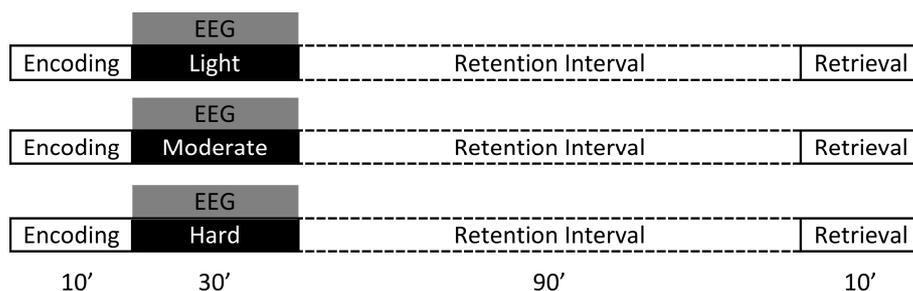


Participants (n = 18) took part in two experimental sessions. Following memorisation, they either cycled with moderate intensity or rested and watched documentaries. Following a retention interval of 90 minutes (watching Friends TV series) they performed an old/new recognition task.

Behavioural data showed a significant improvement in memory performance following cycling (Figure 1).

EEG data showed a negative correlate of theta band activity at F3 (corresponding to dorsolateral prefrontal cortex) with memory performance difference between the two sessions (cycling – rest) (Figure 2).

Study 2



Participants (n = 20) took part in three sessions. They cycled in all sessions following the memorisation phase, but with different intensities.

In contrast to the pilot study, **behavioural data** showed no significant difference between the three cycling conditions (Figure 3).

Conclusions

- Considering results of both studies we speculate that even very easy cycling is enough to significantly improve memory.
- EEG correlate observed in Study 1 provides the first evidence of neural correlate of memory enhancement using physical exercise.
- Negative correlation of theta activity and memory performance is in line with past research showing improved memory performance following lower theta activity during encoding³⁻⁵.

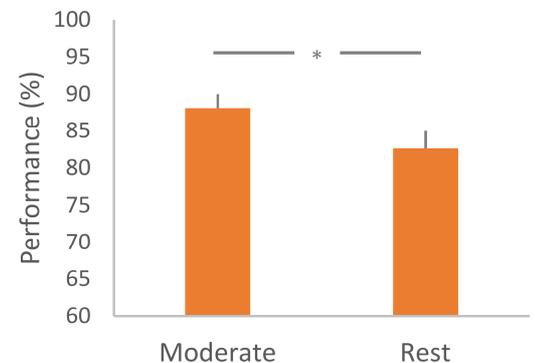


Figure 1. Significant improvement ($p = .02$) in memory performance (Study 1)

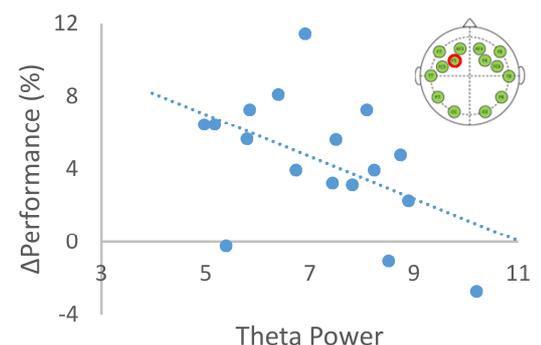


Figure 2. Significant negative correlation ($p = .04$, $r = .48$) of theta power and Δ performance (cycling – rest) (Study 1)

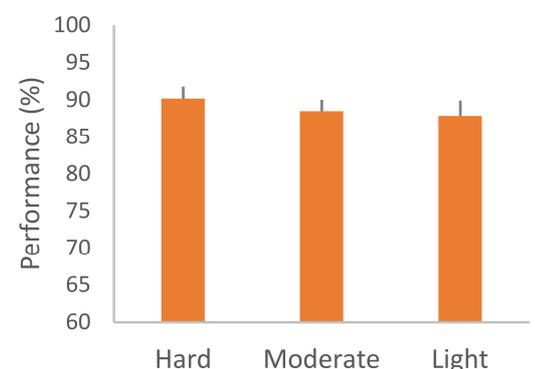


Figure 3. No significant improvement in memory performance (Study 2)

References

- 1 Hillman CH, et al. (2008) *Nature reviews neuroscience*.
- 2 Etner JL, et al. (2006) *Brain research reviews*.
- 3 Burke JF, et al. (2013) *Journal of Neuroscience*.
- 4 Greenberg JA, et al. (2015) *Neuroimage*.
- 5 Long NM, et al. (2014) *Neuroimage*.